THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. VIII.—No. 176.

POST OFFICE TELEGRAPHS.

AN interesting paper was read at the last general meeting of the Society of Telegraph Engineers by Mr. E. Graves, Engineer-in-Chief of the British Postal Telegraph Service. The title of the paper was, "A Decade in the History of English Telegraphy." Coming from a person so competent to make a clear statement of the subject with which he dealt, as the Engineer-in-Chief of the Postal Service, the paper is especially valuable as a defence of the work which has been done and the progress made since the transfer of the telegraph systems of the United Kingdom into the hands of the State. The statements which have been made by various public journals, whether scientific or otherwise, on the subject of the Postal Telegraph system, have been in almost every case the reverse of flattering; in fact, it has been plainly stated that the Service in question is an example of how not to do the work, and that practically no progress has been made, and telegraphic invention has been stifled. Part of this misunderstanding has arisen from estimates drawn up upon a false basis. With regard to the non-encouragement of telegraphic invention, the outcry has been raised mostly by disappointed inventors, who are firmly persuaded that they know far better than those who have had years of experience what the actual requirements of the Service are.

With regard to the actual increase of facilities for transmitting telegrams, the fact is unquestionable that, whereas in 1869 there were but 2,488 offices open, there were in 1879, 5,331 offices, and, as Mr. Graves pointed out, this increase does not represent the actual increase in convenience, since in 1869 there were three and sometimes four competing companies in one town, each of whom had their office, so that in making a comparison, these offices should be only reckoned as one; in other words, the effective number of offices in 1869 could only fairly be reckoned as under 2,000. A similar source of inaccuracy, which has not been observed, consists in the fact, that in estimates of messages transmitted in 1869, a single message has been reckoned as two or three, since each company over whose lines the message passed *en route* to its final destination has the message in question recorded in their totals. If due allowance is made for this fact, the total number of messages transmitted in 1869 cannot be taken to exceed 6,500,000, whereas in 1879 the actual number was 25,547,137.

Complaints of delays have been frequent, and no doubt in isolated cases have been justified, but when we know that the number of fast speed instruments in 1869 was only *four*, whereas in 1879 it was *one hundred and seventy-three*, it can hardly be said that a very great deal has not been done towards getting the work off quickly. With regard to the question of the stifling of invention, Mr. Graves puts the matter very plainly. He says:—"When an alteration would have the effect of throwing out of use a large stock of apparatus in which a very large capital had been embarked, it is clear that such an alteration must be of a very decided advantage to justify the commercial waste, so to speak, that must arise from its adoption. . . . But wherever good has been found, it has been availed of. The inventive genius of our Transatlantic cousins has had a fair field of action in our borders, and its worth has been fully and practically acknowledged."

That we have not found it necessary to go outside the Department for inprovement, is instanced by the examples given of the work now executed by the Wheatstone fast speed instruments, which is of a very remarkable character; this is only a solitary example, but improvements of a steady though not showy character are constantly being made by the engineering staff, improvements which are not heard of, but which are none the less real, as would soon be seen and acknowledged, if it were possible for outsiders to have an intimate knowledge of the internal economy of the Department.

We do not mean to say that the Postal Telegraph Department is perfect; several improvements are no doubt requisite, and must be made in due time. The 6d. rate cannot long be deferred, and an extension of the hours during which the offices are kept open is desirable and must eventually be made. But in spite of the defects, we quite agree with Mr. Graves that the British Postal Telegraph Service is unequalled in the world for efficiency.

THE GALVANOMETER OF MARCEL DEPREZ.

THIS instrument will cause considerable surprise to all physicists who see it for the first time, and will excite wonder that it was not invented before. It is, in fact, a correct and simple carrying out of a principle which is obvious when seen.

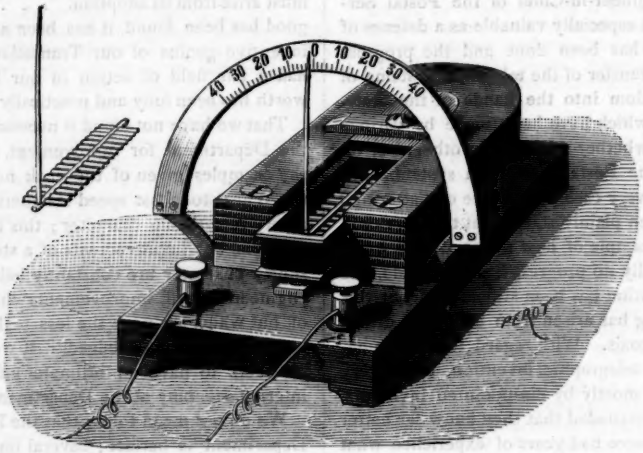
M. Marcel Deprez has invented and constructed a galvanometer suitable for measuring powerful

currents, and for measuring them quickly and directly.

All readers of this journal are aware that powerful currents can be produced, not only by powerful sources, but also by sources relatively feeble, so long as the resistance of the circuit be small. They can see, then, that the instrument once invented could be used for various purposes. This being granted, M. Deprez considered that he could reduce to a minimum the mass of the movable needle and submit it to very powerful actions.

He placed between the horns of a powerful magnet a little needle of soft iron mounted upon an axis passing through its middle. The wire conducting the current, which it is required to measure, is placed between the horns of the magnet and around the soft iron needle; the turns of wire being few in number, their resistance was very small.

An indicating needle of aluminium, or, better still, of straw, acted as an index hand, and completed the instrument.



The directive action of the magnet is considerable, hence it is evident that the deviations with powerful currents can be small; but experiment shows this in a striking manner. When the needle is moved from its position of equilibrium it returns sharply to its normal position, oscillating once or twice with great rapidity.

The action of the current is to cause the needle to spring to its new position. Under these circumstances the oscillations of the needle are still more rapidly brought to rest; they have, in fact, the character of tuning-fork vibrations.

The rapidity of the indications is still greater when the variations of the current strength are less marked. It follows from this that the smallest and the most transient variations of the current are rendered visible by this instrument, whilst the instrument is not affected by external forces.

The apparatus naturally can be made in a variety of forms; the one represented by the figure has been chosen as being the best.

The axis of the needle lies in the general plane of the magnetic meridian.

The needle of soft iron is compound, being composed of from 12 to 18 parallel needles.

The index needle is set at right angles to the magnetic needle, so that its indications can easily be seen on the dial of the apparatus.

Instead of the needles placed side by side in the same plane, a plate of iron formed of several layers touching one another can be used; this second arrangement possesses certain advantages.

A third form has its axis in a direction perpendicular to the plane of the magnet. The index needle in this case is parallel to the plane of the magnet, the dial is set over the magnet, and the apparatus is reduced almost to the size of the magnet.

Other arrangements have also been designed, and can be designed, which will answer various requirements, and upon which it is not necessary to insist.

We will now consider the properties of this instrument. It is evident that the needle cannot be demagnetised, since it possesses no inherent magnetism. Neither is it necessary for the instrument to be set east and west, since the needle, being placed in a powerful magnetic field, is not affected by the terrestrial magnetism. In fact, the instrument can be placed indifferently in any position whatever.

But what is of the greatest importance is, the faculty which the instrument possesses of giving instantaneously the actual measurement of the current, and the accuracy of its indications; this is amply proved by experiments made by various persons who have used the instrument.

If the galvanometer is placed in the circuit of a Gramme machine, all the variations of the velocity of the latter can be seen with the greatest clearness. One can even see the slight movements which show the current not to be a constant one, but to have the character of a wave, a proof which hitherto the

telephone had been the only instrument capable of showing.

We will conclude by expressing our belief that the new instrument of Marcel Deprez is destined to be of great service to the physicist in the laboratory, and to the engineer who has charge of dynamo-electric machines in their numerous applications.

A. NIAUDET.

SIMPLE TELEPHONE TRANSMITTER.

By GEO. M. HOPKINS.

THERE are telephones and telephones, but in the host of instruments so named the successful ones may be counted upon the fingers of one hand. Of telephonic receivers it may as well be said there are but two, for there are only two principles involved in their construction. Of transmitters there are but two that have gained any notoriety and retained their foothold as useful instruments.

Having a chronic liking for telephonic research, I have made it a point to try the various telephones as they have been made known to the public, and have found that with but few exceptions they are defective and useless as practical instruments, and interesting only at exceptional times when the conditions for experiment are favourable, and the adjustments delicately made.

In the course of these experiments the transmitter shown in the annexed engraving was devised, and it was subsequently developed into a usable instrument possessing all of the qualities requisite in a telephone. In the first place, it is so simple as to be capable of construction by the merest tyro, and never needs adjustment. It requires neither call bell, keys, nor switches when used in an ordinarily quiet place, with a closed local circuit.

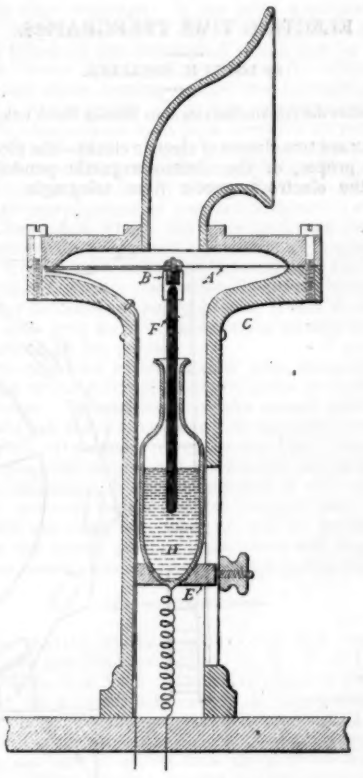
The transmitter is fixed to a bracket and stands vertically, with its sound-collecting mouthpiece pointed in the direction whence the sound proceeds. The receiver, which is an ordinary Bell instrument, stands, when not in use, over a curved pendent resonator, the smaller end of which projects through the shelf of the bracket and just enters the hole in the centre of the receiver mouthpiece.

Between the transmitter and the receiver there is a small induction coil, whose primary wire is connected with the local battery and the transmitter. One terminal of the secondary wire of the coil is connected with the receiving instrument and line, the other terminal is grounded.

The construction of the transmitter will be seen from the figure. The diaphragm, A, has attached to its centre a small brass cup, B, containing a button of ordinary battery carbon three-sixteenths of an inch in diameter, and about the same thickness. This carbon projects beyond the brass cup, and is surrounded by a short paper tube, which projects beyond the face of the carbon one-eighth inch. A piece of copper foil placed between the brass cup, B, and the diaphragm extends to the edge of the diaphragm, where it is pressed by a spring in the cell, C, which is in metallic contact with a wire extending downward through the lower end of the instrument.

The standard supporting the diaphragm cell is hollow, about five-eighths inch internal diameter, and the height of the diaphragm above the bracket is four inches.

In the standard there is a bottle, D, of special form, supported by a ring, E, having a threaded stud extending through a slot in the standard, and provided with a milled thumb nut, by which it may be clamped at any desired height. The bottle, D, has a long narrow neck, about three sixteenths inch internal diameter, and a platinum wire blown in the lower end connects with the local circuit wire, which is coiled to admit of moving the bottle up or down. This wire extends through the base of the instrument, and is connected as shown in figure. The



bottle, D, is partly filled with mercury, in which floats a pencil, F, of carbon of the kind used for electric lighting by incandescence. This pencil is one-eighth inch in diameter, two and one-eighth inches long, and is made slightly convex and very smooth at the ends. The mercury buoys the carbon up so that it is always kept in light and uniform contact with the carbon button, while it also forms part of the conductor in the local circuit. The carbon attached to the diaphragm is perfectly plane on its contact surface, and as smooth as it can be made by means of a fine file.

The diaphragm, which is of mica, has one and three-fourths inches free to vibrate. It is rather stiff, and is clamped firmly in its cell. The surfaces between which the diaphragm is clamped are perfectly true, and made of material not liable to warp. Wood well soaked in paraffine answers a good purpose, but vulcanite is far better.

The induction coil used with the instrument is of the ordinary form, two inches long, one inch in diameter, with a three-eighths inch core of No. 18 soft iron wires. The primary coil consists of three layers of No. 18 silk-covered copper wire, and the secondary of No. 36 in sufficient quantity to fill the spool. One cell of Leclanché or Fuller battery will work the transmitter, but two will augment the volume of sound.

As to the efficiency of this instrument, it will bear comparison with other transmitters, and in one or two points it seems to have an advantage. It will transmit speech clearly whether the speaker is within ten inches or as many feet of the instrument. Although a call bell may be used in connection with it, generally none will be required, as by saying o-o-o-o loudly in the mouthpiece a trumpet-like sound is heard in the receiver at the other end of the line, which, although not very loud, is sufficient to attract attention in a measurably quiet room.—*Scientific American.*

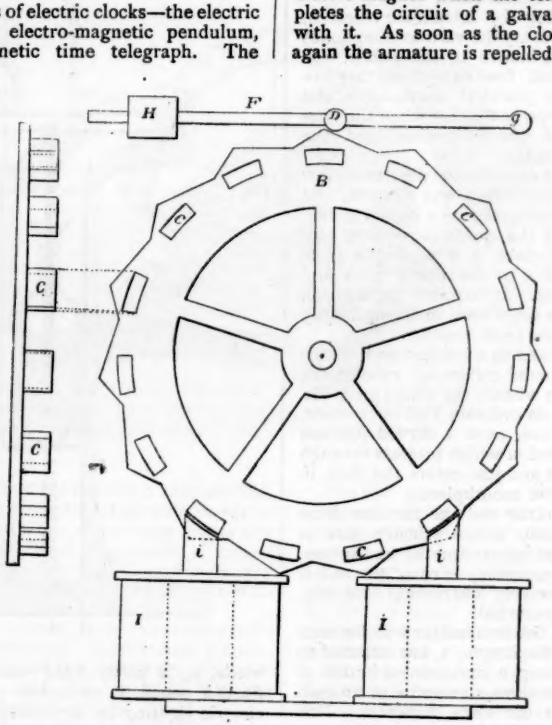
ELECTRIC TIME TELEGRAPHS.

By LOUIS H. SPELLIER.

Read before the Franklin Institute at its Meeting March 17th, 1880.

THERE are two classes of electric clocks—the electric clock proper, or the electro-magnetic pendulum, and the electro-magnetic time telegraph. The former has been to this day more of a scientific curiosity than a useful invention. It is only the latter, the electric time telegraph, which has proved a partial success. As the name indicates, they are instruments which receive the time telegraphed. For this purpose a standard clock, which in certain intervals of time completes or breaks the circuit of a galvanic battery, is needed. Although many and various in construction, they all resemble each other very closely in their most essential parts.

They mainly depend upon the action of one electro-magnet and one armature. The latter is a piece of iron, which is attracted by the poles of the electro-magnet when the telegraphing clock completes the circuit of a galvanic battery connected with it. As soon as the clock breaks the circuit again the armature is repelled to its former position



by a spring or weight. This movement of the armature turns a wheel which drives time-indicating machinery, and is repeated as often as this machinery requires to indicate the time of the clock, which makes or breaks the electric circuit.

Such instruments work very well if the action of the armature is needed about once every minute, but if repeated every second or two, then its im-

perfections become apparent. The movement of the armature is sudden and rapid. With a lightning-like velocity the armature moves toward the magnet, and is checked instantaneously in its rapid progress just at a time when nearest the magnet and most powerfully attracted. Naturally the wheel, which receives its moving impulse directly from the armature, moves with the same rapidity and is checked as suddenly. Those sudden checks, offered to the armature and wheel, show their damaging results in a comparatively short time, and soon impair the correctness of such instruments.

In correcting these destructive evils I never succeeded completely until an entirely new system suggested itself to me, and of which the accompanying figure shows the principle.

Instead of one armature I have a number of them, C, fastened at equal distances around the circumference of wheel B. With B on the same axle another wheel is fastened, having as many cogs, of the peculiar shape shown in the figure, as B has armatures. F is a lever with its oscillating centre at *g*, and has a pulley, D, which presses against the circumference of the wheel, B, by the weight, H. I *i* is the electro-magnet. The electro-magnet is connected with a galvanic battery, of which the circuit is closed and opened by the oscillations of a pendulum. The instrument acts in the following manner :—

When the current of the galvanic battery is closed, the armature, C, will be attracted by the electro-magnet, and move A and B in the direction indicated by the arrow, and stops as soon as C is directly over it. When in this position the pulley, D, rests upon the upper part of the cog, and presses against it. As soon as the electric current is disconnected, and the electro-magnet discharged of its magnetism, the pressure of the pulley, D, against the cog moves B in the direction indicated by the arrow, and stops moving when the pulley has reached the deepest point of the cog. This movement of B has brought the next armature, C, near to the magnet, *i*. This armature will now be attracted at the next closing of the electric current. Then B will be moved again, and the cog will take the first position, and the pulley, D, presses upon it, ready to move the wheel as soon as the electro-magnet is again discharged of its magnetism ; and so on alternately, the electro-magnet and the pulley will interchange their action, and keep B revolving in the manner as the pendulum of the clock connects and disconnects the electric current.

The object in view, to avoid the sudden check to the armature, is hereby accomplished. No sudden check is offered to the armature, but when attracted it swings for a moment in short vibrations over the magnet before it comes to rest. It is comparatively noiseless in its movements, its sound being hardly perceptible. In this respect it is very much unlike other time telegraphs, whose clapping noise is their constant companion.

A time telegraph of this kind in operation at the monthly meeting of the Franklin Institute had, like the accompanying figure, fifteen armatures (the wheel on which they were mounted measuring five inches and one-half in diameter), and two electro-magnets. With six cells of a Daniell battery it proved to have ample power to drive four dial works for dials 5 feet 6 inches in diameter. It may have as many electro-magnets as it has armatures. This is a circumstance of some importance, since it will increase its driving capacity with each additional electro-magnet without adding materially to the size of the instrument.

Whatever the reason may be, there is no doubt that, to this day, the time telegraphs have not received such notice as they really deserve. Their service can be more useful and general than is mostly admitted. If we consider that we can control by one correct time-piece just as many time telegraphs to indicate true time as necessity or fancy requires, providing there is battery power enough to move them, we have reason to believe that they still may come into general use in hotels and public buildings, where true and equal time in every room of the house is desirable.

But there is still another field of great importance for the time telegraph. It has been a problem of great perplexity, to this day, with the most ingenious minds of the horological world, how to construct clocks which will overcome the effects of wind and storm beating against the exposed clock dials of public clocks. It is true, remontoires and gravity escapements have been invented to remedy the evil, and clocks may go better with them than without them ; but, nevertheless, all these ingenious contrivances have almost as many evils, on account of their complication, as they are designed to avoid. And here it is where the time telegraph has its future. A well-regulated clock, kept at a place of even temperature, will show but very little variation of time. If such a clock controls a time telegraph adapted for tower or public clocks, it will show the time with only such slight variation as will hardly be noticed by the public.

One objection raised against time telegraphs—the use of the galvanic battery—can be an objection no longer. Its treatment is now almost generally understood, since it has found its way into so many branches of business of every-day life. There is little room left to doubt that when the utility of the time telegraphs is once recognised it will receive more deserved notice and be brought into more general use ; and the time may not be far distant when the subtle power of electricity will regulate all our better class of tower or other public clocks.

OIL TESTING BY ELECTRICITY.—A new method of testing oils has been devised by Mr. F. S. Pease, of Buffalo, New York. The oil is placed in a vessel placed in a water-bath which is supported in a closed heating chamber ; a small dome with a glass window at the top of the chamber has two insulated wires led into it whose ends are a short distance apart. When the oil is heated to a certain point the inflammable vapour is given off and this can be ignited by a spark between the two wires generated by an induction coil. In the ordinary system of testing, the light to ignite the vapour has been applied indiscriminately at any point above the level of the liquid, and unless this height is the same in all tests different results are obtained ; other sources of error also exist unless the conditions for making the test are similar. By Mr. Pease's device these effects are entirely got rid of and accurate and trustworthy results obtained.

JOHNSON AND PHILLIPS' PATENT MARK BUOY.

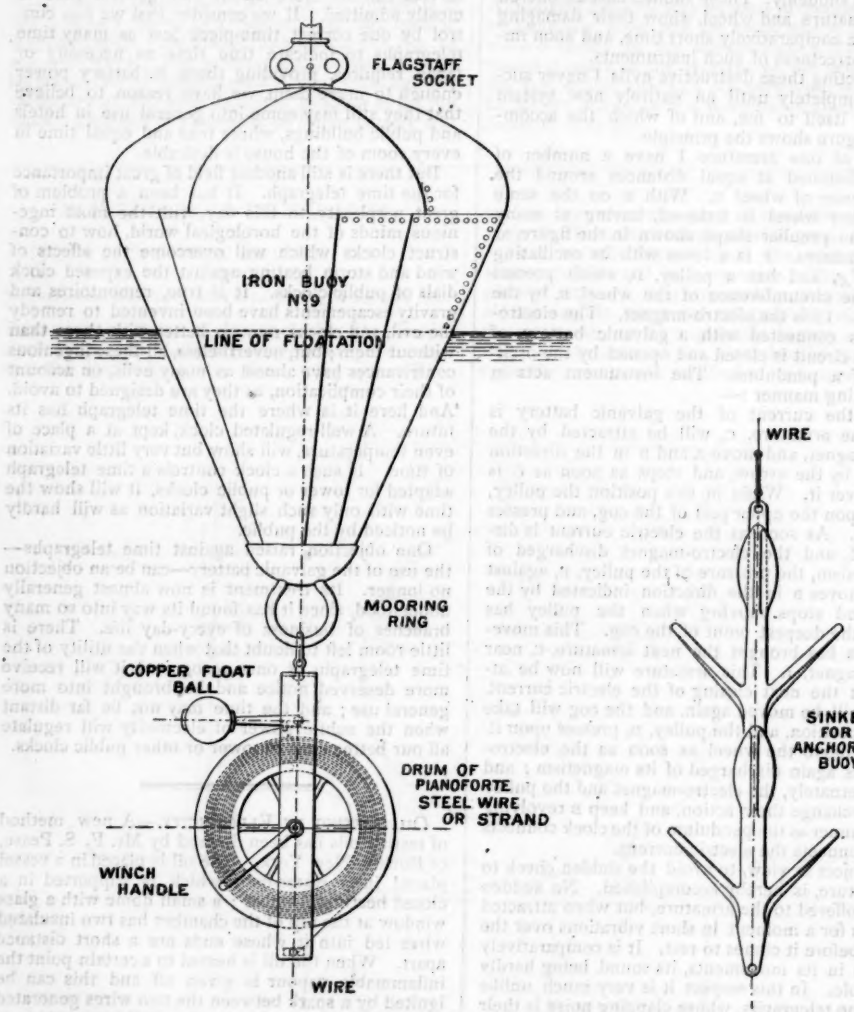
THE object of this arrangement of moorings is that vessels employed in laying or repairing Submarine Telegraph Cables may be provided with a means of marking a "position" without the loss of time which usually attends this operation, and at a comparatively small cost.

The buoy is suspended over the water by a line made fast at any convenient projection at the quarter or stern of the vessel, so that when this line is cut through, the buoy will drop into the water, clear of the ship's side.

These buoys are made in several sizes; a reference to the annexed drawing will show the arrangement of parts when in working position.

The action of the apparatus is as follows:—On letting go the buoy, the copper float ball, which operates a catch or detent, is lifted, and the drum containing the steel wire is free to revolve. The drum then pays out the whole of the wire, the length of which should be considerably in excess of depth of water. A winch handle is provided, so that the moorings may be recovered, but the cost of a sinker and mooring wire is so small, that, as a rule, it will not pay to recover it.

Several drums containing length of wire suitable for different depths of water are provided, and these are easily placed in the drum frames.



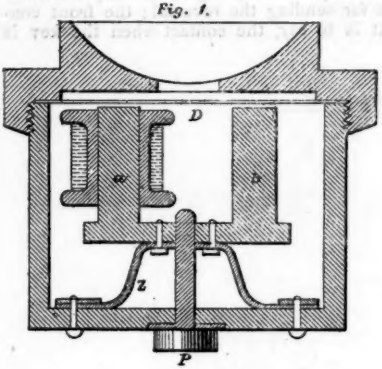
AN ELECTRO-MAGNETIC TELEPHONE RECEIVER.

IN our issue of May 1st, 1879 (No. 150, vol. 7), we described Mr. Louis J. Crossley's modification of the Hughes microphone, which has already attained to a very high position as a telephone transmitter.

This must alike prove a source of satisfaction to Professor Hughes, who discovered the germ, and to Mr. Crossley, who developed it into the present efficient instrument.

In the article we have referred to, the apparatus was illustrated as working with an ordinary Bell telephone.

Fig. 1.



We have now the pleasure of describing an electro-magnetic telephone receiver, which is being used in conjunction with the Crossley transmitter with very satisfactory results.

One form of this instrument is illustrated in section by fig. 1. The electro-magnet, *a*, *b* (carrying one bobbin of wire), is firmly screwed to the steel spring, z, which is screwed down to the case of the instrument by means of two screws from the outside.

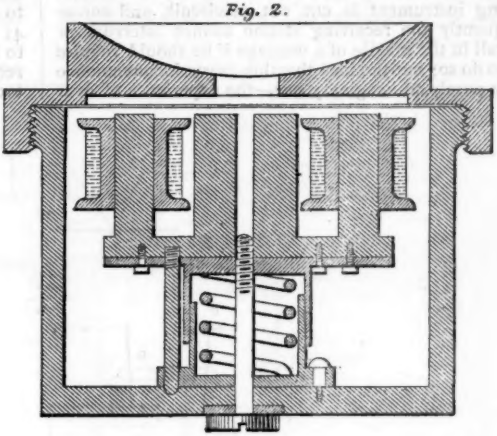
A thin iron armature, D, is cemented down on one side to the top of the wooden case, the other end being left free.

The instrument having been adjusted by means of the screw, P, is filled with paraffin wax to within half an inch of the top, in order to reduce the cavity inside the case and thus render the tone purer.

Another form of the receiver is shown by fig. 2. This instrument has a somewhat different adjusting spring to the first form, and has two electro-magnets in place of one.

The internal connections of the transmitter are so arranged that when the receiver is lifted off the switch, ready for speaking to, a current flows out

Fig. 2.



through the receiver to line, thus magnetising the receiver, which is, of course, essential to the proper working of the apparatus.

From this it will be gathered that the volume of the sound in the receiver depends largely on the strength of the current flowing in the line and receiver, and that by proper arrangement this may be so augmented as to become comparatively loud.

With lines up to 9 miles in length, 6 Leclanché cells are said to give very satisfactory results.

TELEGRAPHIC APPARATUS IN USE IN THE BRITISH POSTAL TELEGRAPH DEPARTMENT.

X.

DOUBLE CURRENT SYSTEM—(*continued*).

Faults.

THE faults to which the Double Current system is liable are chiefly due to defects in the key. If the pad under the front of the lever is screwed too high up, contact will not be made by the upper contact springs; a like fault will occur if the latter be bent up or broken. Dirty contacts seldom if ever occur, as the comparatively long play of the lever gives rubbing surfaces. The switch contacts may fail from the levers of the same being bent, or, again, the ebonite connecting bar may be broken; such faults ought, however, never to occur, as they can only be due to very rough handling.

It can easily be seen if the key works properly, by observing the galvanometer needle; the latter should move to the left when the switch is over to "send," and the key in its normal position, but should move to the right when the latter is depressed.

In order to determine whether an interruption is caused by a line or an instrument fault, terminal of the key should be connected by a piece of wire to the right-hand terminal of the galvanometer, the other connections remaining undisturbed; on turning the switch to "send" and working the key, signals ought to be produced on the receiving instru-

ment, which signals, however, will be reversed, that is to say, the key in its normal position will "mark," and, on being depressed, will "space." This will show that the receiving apparatus and the battery are in proper condition.

If, when the switch is at "receive," wires from the battery terminals, z and c, be touched to terminals 7 and , then the receiving instrument should respond.

The attempts which have been made to get rid of the "switch," which is provided with every double current key, have been very numerous and unsuccessful. These attempts have almost all been made by persons entirely unacquainted with the practical working of double current circuits. It is quite true that when the switch is over to "send," the receiving instrument is cut out of circuit, and consequently the receiving station cannot interrupt or call in the middle of a message if he should require to do so; but the idea that this causes inconvenience is purely an imaginary one—the experience of over 20 years has proved that no trouble arises from the supposed defect. Again, it has been argued that if the switch is not moved over from "send" to "receive" at the completion of a message, the circuit will practically be broken down, as the distant station cannot call. As a matter of fact, a fault arising from this cause is of very rare occurrence indeed; from constant habit, the movement of the switch, when working is commenced or ceased, becomes such a mechanical motion with the operator that it is done almost unconsciously. But even if it did happen that the switch was not moved over to "receive," the movements of the galvanometer needle, which, as will be seen from fig. 40, Article VIII., is in the line circuit, would at once indicate that the distant station is calling; these movements would be almost certain to be noticed, as in a busy office (where alone the double current system would be employed) clerks are always in attendance and looking out for a call.

But even if the abandonment of the hand switch were considered advisable, it is certain that it is not possible to cause it to act automatically by the back movement of the key, that is to say, to cause the key after it has sent the reversal to put the line through the receiving instrument. It must be remembered that the idea of getting rid of the hand switch is to enable the distant station to call "whilst a message is being sent," consequently no device for moving the switch automatically "on the completion of the message" would be of any use. The reasons for concluding that no arrangement for the purpose indicated can be designed, are as follows:—

To enable double current working to be thoroughly efficient, it is very necessary that the duration of the contacts be as long as possible; so well is this known to be the case, that spring contacts similar to those shown in the double current key, fig. 41 (Article VIII.), are always used and found to be necessary. The spring contact is particularly requisite for sending the reversal; the front contact, that is to say, the contact when the key is depressed, may, without inconvenience, be made "dead," as in the single current key, but the back contact must be a spring. The reason of this is to be found in the fact that there is a natural tendency in the operator to dwell longer upon the front contact than upon the back contact, and therefore there is a tendency to cut short the reversal current due to the former; but the actual duration of the reversal is, in practice, sufficiently long, because the contact remains on:—1st. For a portion of the time during which the key is rising. 2nd. For the whole time whilst the key is at rest on the back contact (which period is of lengthened duration); and 3rd. For a portion of the time during which the key is being depressed. Now the total duration due to all these three periods, and especially to the second, is by no means too long when quick working over long lines takes place, and to cut it short would be to seriously impair the signals, more especially when we consider that the marking and spacing currents will be of very unequal duration. To switch in the receiving

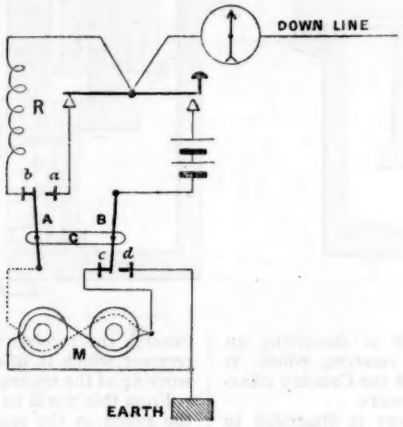


FIG. 48.

instrument for a portion of the time during which the reversal current ought to be flowing must obviously cut the latter short, and this is what must be done if an automatic switch is introduced; the impossibility of using the latter is, therefore, as obvious theoretically as it is found to be practically.

DIRECT WRITER DUPLEX SYSTEM.

In the ordinary Morse duplex system, as is well known, the lever of the transmitting key is connected to the two ends of the differential coils of the electro-magnet, the other end of one coil being connected to line, and the other end of the second coil being connected to the artificial resistance; then if the key is depressed so as to make contact with the battery, the current from the latter splits, half going through one coil of the electro-magnet and then through the line to the distant station, whilst the other half goes through the second coil of the electro-magnet, and then through the artificial resistance to earth. Now, it is evident that the same result will be obtained if the one half of the current goes first through the line and then through the one coil of the electro-magnet, whilst the other half goes first through the artificial resistance and then through the second coil of the electro-magnet. The latter arrangement is the one adopted in the Postal Direct Writer instruments for a special reason. The successful working of the duplex system of course depends upon an accurate balance being obtained; and in England, where climatic changes are very frequent, it is sometimes extremely difficult to preserve this balance, in such a case duplex working becomes practically out of the question, and ordinary single working must be resorted to. In order that the change in the connections, necessary to convert the one system into the other, may be made without loss of time, all the duplex direct writer instruments are now fitted with switches, by the turning of which the required change is at once made. Now this result can be effected in the simplest manner and with the fewest changes of connections, if the duplex arrangement is made in the manner which has been referred to, consequently it is the one now adopted.

Fig. 48 shows the theoretical arrangement of the connections. A, B, are two levers linked by the bar, C, so that they move together. In the position indicated in the figure, the apparatus is arranged for duplex working; the action may then be explained as follows:—On depressing the key

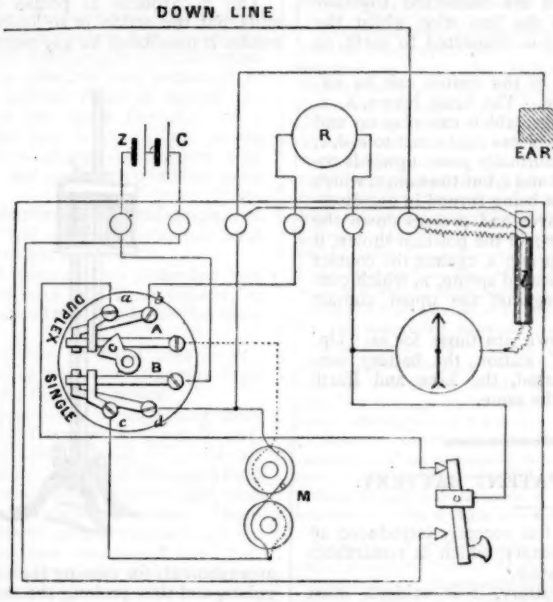


FIG. 49.

the one half of the current flows out to line and back through the earth at the distant station to "Earth" at the sending station, and thence through the coil of the instrument, represented by the continuous line, to contact point, *c*, and from there through lever, B, back to the battery. The other half of the current flows through the balancing resistance, R, to contact point, *b*, and thence through lever, A, and the coil of the electro-magnet, represented by the dotted line, back to the battery.

For single working, the levers are moved over against contact points *a* and *d*. In this case, when the key is depressed, the whole of the current from the battery passes to line, since the end of the resistance coil is disconnected at the contact point, *b*, and the Zinc pole of the battery is direct to earth through lever, B, and contact point, *d*. If a

current is received from the distant station when the key is at rest, then the current enters through the lever of the key and its back stop, from there it passes to contact point, *a*, thence to earth through the lever, B, and both coils of the electro-magnet, in the directions tending to magnetise the latter.

The Directer writer duplex instrument, in outward appearance, is similar to the ordinary Direct writer (Article IV.), but it has one more terminal, and the switch attached to it.

The actual arrangement of the connections will be seen from fig. 49. The lightning protector, *l*, connections in this case are slightly different from those adopted in the Direct instruments. In the latter the Up line passes through one wire of the protector, and the Down line through the other wire; in the duplex instruments, where the stations are of course never "Intermediate," but always terminal, the two protector-wires are connected together and are in circuit with the line wire, whilst the brass barrel of the same is connected to earth, as shown.

The mechanical form of the switch can be understood from the figure. The brass levers, A, B, are in reality brass springs, which can play up and down between the angle pieces connected to *a*, *b*, *c*, and *d*. These springs normally press upwards towards the angle pieces, *b* and *c*, but the cam, C, which is moved by a handle, on being turned in one direction or the other, slips over and presses down the one spring or the other; in the position shown, it has pressed down the spring, A, against the contact piece, *b*, whilst it has released spring, B, which consequently is pressing against the upper contact piece, *c*.

The connections shown are those for an "Up" station; at a "Down" station, the battery connections will be reversed, the Line and Earth connections remaining the same.

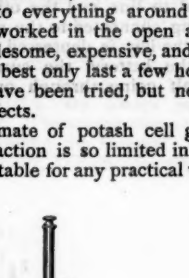
ANDERSON'S PATENT BATTERY.

MR. R. C. ANDERSON has recently introduced an improved zinc-carbon battery, which is remarkable for its power and constancy.

Any new form of battery, it is evident, must possess many advantages and great improvements over all previous cells, to enable it to compete with those forms which have long been established and used.

The Leclanché and the manganese cells have each obtained great favour on account of the very slight amount of local action which takes place, thus enabling them to be left unattended for long periods, as in the working of electric house bells. In a certain class of telegraphic work they rapidly polarise and require inconvenient intervals of rest, while the rapid fall in electro-motive force is annoying and troublesome to the operator, and for any work requiring great quantity of current, as, for instance, the electric light, they are quite useless. The Daniell cell and its various modifications, which have been, and are, extensively used for telegraphic purposes, require frequent renewal, and, if unattended for any length of time, become almost useless by deposition of crystals and action on the plates. Many other forms of constant batteries have also been tried, but all have failed in actual work to win the approval of electricians, by reason of various defects; while some are so expensive in first cost, and troublesome and expensive to maintain, as to be out of the market. When a battery of large quantity has been required, either Grove's (platinum and zinc) or Bunsen's (carbon and zinc) combinations have been used. These cells undoubtedly possess the merit of good electro-motive force and low resistance, with freedom from polarisation, but the fumes emitted are so deleterious to everything around that they can only be safely worked in the open air, while they are most troublesome, expensive, and dirty in working, and at the best only last a few hours in action. Many forms have been tried, but none have overcome these defects.

The bi-chromate of potash cell gives good results, but the action is so limited in duration as to render it unsuitable for any practical work, while all



arrangements for causing the exciting fluid to circulate, and thus prolong the action, are both complicated and costly.

These difficulties in the construction and working of galvanic batteries, Mr. R. C. Anderson has, after long and exhaustive experiments, almost entirely overcome, and, in his patented improvements, produced a cell which can be used either as a single or double fluid battery for constant or for occasional work, and in which great electro-motive force is combined with the highest freedom from polarisation and remarkable constancy, while the complete cell compares favourably with any of the forms of batteries hitherto in use, both in simplicity of construction, first cost, and working expenses.

The new battery is made either as a single fluid without porous division, or as a double fluid with porous cell. In either case the elements are carbon and zinc, excited by a mixture of muriatic acid and bi-chromate of potash, with addition of a small quantity of patent compound salts, which together constitute the novel points in the battery.

The single fluid cells are most suitable for any purpose requiring great power with constancy for a period not exceeding ten to fourteen hours.

A single cell of this arrangement, exposing an effective zinc surface of 36 square inches, maintained a current on a closed circuit of 5 ohms resistance, for ten hours without variation, being equal in quantity to two Grove cells, each exposing 30 square inches of zinc surface, thus exhibiting nearly 75 per cent. higher results.

The battery does not give off offensive fumes.

The double fluid battery is a very useful invention. The zinc is placed in the inner or porous cell, in which the excitant is R. C. Anderson's patent salt dissolved in water. The carbon is placed in the outer cell, in which the excitant is a mixture of muriatic acid and bi-chromate of potash solution, with addition of the patent salts.

Owing to its greater internal resistance, the current strength of this battery is less than that of the single fluid form, but its constancy is so far increased that a cell exposing an effective zinc surface of 12 square inches gave a current equal in quantity to three Leclanché cells (or three Daniell's), on a closed circuit, for seventy hours. This power was maintained with slight variation, and only in the last few hours did the electro-motive force diminish.

If used for intermittent work, as in telegraphic or telephonic circuits, it will continue in action from six to eight months without attention.

A peculiarity in the battery exists in the fact that the zinc remains clean and free from deposit, its consumption being remarkably small for the work done.

The electromotive force of these cells is 2·15 volts, and their resistance very low, from the high conducting power of the fluids employed.

We lately had an opportunity of inspecting some of these new batteries at the manufacturers, Messrs. Dale and Crampton, of Little Britain, E.C., and can testify to their efficiency. Thirty of the single fluid cells gave a powerful and steady electric light with one of Messrs. Crampton's electric lamps. These lamps, a figure of which we give, are remarkable for their extreme simplicity and consequent low cost. In principle they are very similar to the Brush lamp. The top carbon slides in a tube between the two bobbins of an electro-magnet, and the armature, which is in two pieces, clutches hold of the top carbon, and then lifts it up, so as to produce the arc.

Fifteen cells of the battery connected to one of Messrs. Dale and Crampton's induction coils, containing 200 yards of primary, and 14 miles of secondary wire, produced a dense 20" spark, a remarkable performance for a coil of the size.

IN the first four months of 1880 the receipts for telegrams in France have been increased by 1,500,000 francs, but the postal department lost one-sixth of that amount. This result shows that owing to the low rate of telegrams in France (½d. per word) and the increased postage (1½d. per letter), telegraphy is gradually taking the place of ordinary letters.

Notes.

THE MCMAHON TELEGRAPHIC NEWS AGENCY, working the patents of the Exchange Telegraph Company, is, we hear, very successful. In reporting all great events it effects a saving of time of from twenty minutes to one and a half hour over the hand-delivered telegrams of the old fashioned systems.

THE result of the City and Suburban race, handed in at Epsom at 4.20, was delivered at 4.25; of the Manchester Cup, handed in at 4·20, delivery was effected at 4.27½; and the Derby, which commenced at 3.19, was telegraphed to London and re-transmitted to 300 places in London by 3.37, these places extending from the top of Oxford street to the Tower. In this last instance the rapidity is not only very creditable to the Agency but also to the Post Office Department, in conjunction with which the speed was attained.

TELEGRAPHING EXTRAORDINARY.—The Superintendent of Telegraphs (Mr. C. Todd, C.M.G.) has kindly supplied us with the following information:—On Sunday morning, the telegraph lines being clear of business, Melbourne and Port Darwin were put in direct communication with each other, the distance between the two places being 2,500 miles. The signals were perfect at each end, the line working splendidly right through, and the replies were instantaneous. The cable was then cleared, and communications exchanged with Singapore, a further distance of 2,200 miles, or 4,700 miles from Melbourne. Replies were received from Singapore in a few seconds, a message being sent and a reply received in the space of one minute from the commencement of the message. The messages had, of course, to be repeated at Port Darwin, but this was done simultaneously, so that little or no time was lost. Port Darwin and Singapore were in direct communication through the duplicate cable recently laid, which avoids the necessity of using the land line through Java. Since the duplicate cable has been submerged the time occupied in the transmission of messages between London and Adelaide is greatly reduced, seldom occupying more than a few hours, and from Adelaide they invariably beat the sun, arriving at their destination in advance of the local time they were handed in.—*South Australian Register.*

GENERAL ANSON STAGER has resigned the office of General Superintendent of the Central Division of the Western Union Telegraph Company, increase of work having rendered it necessary that he should devote the whole of his time to the duties of the vice-presidency of the company.

MR. GEORGE PRESCOTT, for more than ten years past the Electrician of the Western Union Company, has resigned that position to take charge of the Gold and Stock Telegraph Company as vice-president and executive manager. Under Mr. Prescott's administration of the electrical and engineering department, the construction and operation of the lines have been systematised and greater economy introduced. Special attention has been given to economy in the construction and use of batteries, the cost of which has been reduced to about 25 per cent. per mile of line, as compared with that at the time he was appointed electrician, while their efficiency and reliability has been greatly increased. The work of the electrical and engineering department has been transferred to a bureau in the department of vice-president Van Horne. Mr. Prescott has also been elected President of the American Speaking Telephone Company.—*Journal of the Telegraph.*

IT is officially announced that on and after June 1 the charge for telegrams to Germany will be reduced from fourpence to threepence for each word.

IT is proposed to employ the electric light in lighting the Sheldonian Theatre and the Radcliffe Library, now used as a reading room of the Bodleian Library at Oxford University.

THE line of telegraphs between Dalmally and Oban, a distance of 25 miles, was completed recently, and the stations fitted with the necessary apparatus for the transaction of a complete railway telegraphic service. The whole work has been executed by Mr. Dunn, of the Caledonian Railway Company.

DR. SIEMENS' paper on "The Dynamo Electric Current in its application to Metallurgy, to Horticulture, and to the transmission of Power," which has been postponed owing to the indisposition of the author, will be read before the Society of Telegraph Engineers on Thursday, June 3rd.

SOME satisfactory trials have recently been made with the Brush electric light on board the *Inflexible*. We hear that the system is to be adopted on several of Her Majesty's war vessels.

THE *Journal de Physique* contains a description of some experiments of Herr Koch on the so-called electromotograph effect discovered by Edison. When a plate of platinum or palladium is put in contact with a plate of moistened glass and polarised, the friction between the two becomes reduced. Herr Koch measures the amount of this friction in the following manner:—The metal is formed into a small button which forms the lower pivot of a magnetic needle. This pivot rests on the bottom of a glass cup containing a small quantity of water, if now the needle be set oscillating the number of vibrations it will make before coming to rest will represent the amount of friction between the metal pivot and the glass surface on which it rests. If one pole of a battery be connected to the metal pivot and the other pole to a platinum wire dipped in the water, then the amount of friction becomes modified. When the battery connections are such that hydrogen is developed on the pivot, no alteration in the friction is produced; but if oxygen is formed then the friction becomes considerably increased, in the ratio of two to three or four. The increase appears immediately on closing the circuit and disappears immediately on reversing the current, but only slowly diminishes when the circuit is opened. It increases with the electromotive force. Palladium behaves like platinum, but 18-carat gold gave no effect.

M. MARCEL DEPREZ has succeeded in inventing a system by means of which angular velocity may be transmitted electrically to a distance. The apparatus consists of a transmitter with a double commutator, an electro-motor forming the receiver, and two conducting wires (one from each commutator). On the shaft of the transmitter are fixed the two commutators, each of which reverses the current that traverses it twice each turn; but the positions of the shaft corresponding to these inversions do not coincide; they follow each other at intervals of a quarter of a turn. The receiver consists of a permanent magnet or electromagnet, between the branches of which are two straight electro-magnets, capable of rotating round an axis which coincides with that of the magnet. The currents sent through these electro-magnets from the transmitter produce the required rotatory movement. The currents required to drive the receiver may be generated by a magneto-electric machine or by a battery. For every position of the axis of the transmitter there is one position—and one only—of stable equilibrium for the axis of the receiver. Hence the axis of the receiver follows all the movements of the transmitter; turns at the same rate and in the same direction as the transmitter may be turned; and makes the same number of revolutions precisely to within a quarter of a revolution.

DR. C. GORE, F.R.S, has recently brought before the Royal Society the results of some preliminary experiments on the Effects of Electric Currents on the Surfaces of Mutual Contact of Aqueous Solutions. In the year 1859 the author made the following experiments, for the purpose of ascertaining whether visible movements, similar to those obtained by passing an electric current through mercury and an aqueous solution, could be obtained by passing a current through the surface of mutual contact of two aqueous liquids alone:—"1st. A definite layer of oil of vitrol was placed beneath a layer of distilled water weakly acidulated with sulphuric acid, and the terminal wires of a voltaic battery immersed in the upper liquid; no visible movements occurred at the boundary line of the two liquids. 2nd. A dense solution of cyanide of potassium was placed in a small glass beaker, a few particles of charcoal sifted upon its surface, and a layer of aqueous ammonia, half an inch deep, carefully poured upon it. A vertical diaphragm of thin sheet gutta-percha was then fixed so as completely to divide the upper liquid into two equal parts; the vessel was placed in a strong light, and two horizontal platinum wire electrodes, from sixty-six freshly charged Smee's cells were immersed one-eighth of an inch deep in the liquid ammonia on each side of the diaphragm. A copious current of electricity circulated, but no movement of the liquids at their mutual boundary line could be detected."

Recently, also, the author made similar experiments but in a much more searching manner, in order to ascertain whether an electric current, passing between two aqueous liquids, affects their diffusion into each other. The essential difference in the form of these experiments from that of the above mentioned one was to concentrate the action of the current upon a very much smaller surface of contact of the liquids, and thus render any visible effect upon their diffusion more manifest. After making several forms of apparatus, in order to obviate certain difficulties of manipulation which arose and were fatal to success, it was found that, when an electric current was passed between the surfaces of mutual contact of certain aqueous solutions of different specific gravities, the boundary line of contact of the two liquids became indefinite at the surface where the current passed from the lighter into the heavier solution, and became sharply defined where the current left the heavier liquid and re-entered the lighter one; and that on reversing the direction of the current several times in succession after suitable intervals of time, these effects were reversed with each such change. Also, in various cases in which the contiguous boundary layers of the two liquids had become mixed, the line of separation of the two solutions became, by the influence of the electric current, as perfect as that between strata of oil and water lying upon each other. In rarer cases two such distinct lines of stratification apeared. Other new phenomena were also observed.

EVERY practical electrician knows the trouble that is occasioned in battery cells by what is known as "creeping," that is to say, the tendency of the liquid in the cells to deposit crystals on the sides of the jar above the level of the liquid, which crystals act as a

kind of siphon when the crystalline formation reaches the top of the jar, and drain off a quantity of the liquid out of the cells. A correspondent, writing to the American *Journal of the Telegraph*, gives a remedy for this troublesome action; he says:—

"Instead of using oil in battery cells I use tallow, which I think much cleaner and better adapted to the purpose. The tallow should be melted, not sizzling hot, but just enough to liquefy it. A sufficient quantity to form a crust half an inch thick over the surface should be poured into each jar. As tallow hardens immediately upon coming in contact with water, the jar is at once sealed up with a substance easily procured, easily handled, and, if necessary, easily removed. A pound of tallow costing five or six cents will seal up half a dozen jars, and when sealed up in this way they will require very little attention. If it be necessary at any time to add sulphate of copper it can be introduced by merely making a small hole in the crust, which is easily filled up with a little melted tallow. A cell should not be thus sealed up except when in good condition—work it up to its proper stage, then seal it. One great advantage in thus sealing the cell is, that it keeps the edge and sides of the jars clear of the crystallisation which is so annoying, and keeps them clean and nice. I set my local cells alongside my instruments since they have been sealed up, and find them not at all objectionable. Mutton tallow is preferable, but beef tallow will do nearly as well. Of course the cell must have sufficient water to allow of the formation of the crust without its touching the zinc."

THE EFFECT OF LIGHTNING ON TREES.—Our Geneva correspondent writes, under date May 12:—"A few days ago, during a violent thunderstorm, a tall poplar on the Cour de Rive, a street in the upper part of Geneva, was struck by lightning. Directly after the occurrence Professor Colladon, the eminent physicist, and one of the consulting engineers of the St. Gothard Railway, made a minute examination of the tree, and his observations, more especially as they are opposed to some generally received theories, and relate incidentally to the right construction of lightning conductors, may be not uninteresting to many of your readers. After remarking that his conclusions are based on the careful investigation of sundry similar phenomena, the professor goes on to say that it is not true, as has been commonly supposed, that the gashes (*plaies*) found in the trunk of a tree which has been struck by the electric fluid are the parts with which the lightning first came into contact. The parts first struck are the highest branches, especially those most exposed to the rain. Thence it runs down the smaller branches—affecting almost the whole of them—to the larger ones until it reaches the trunk. These large branches, and above all the trunk, being much worse conductors than the small branches, the passage through them of the fluid produces heat and 'repulsive effects' whereby the bark and sometimes the wood are torn in pieces, the bits being thrown a considerable distance, occasionally more than 50 metres. This theory, says Professor Colladon, is the result of numerous observations. It not infrequently happens that the upper branches and their leaves are destroyed—this is generally the case with oaks, which are often struck—but the leaves and young shoots of poplars and many other trees are such excellent conductors that they do not appear when struck to suffer any notable injury. This rule is so general that, though their trunks may be rent and their bark torn off, not more than two or three poplars out of 100 struck by lightning have their leaves shrivelled or even discoloured. This induction finds full confirmation in the condition of the poplar on the Cour de Rive, for it is not often in Switzerland that trees are struck by lightning early in May, when their leaves are young and tender. In this instance the principal and highest branch of the tree, on its south-western side, was the first with which the fluid came in contact. Its leaves and twigs, neither withered nor tarnished, were torn into minute fragments and scattered about on the ground. This was the effect, not of the lightning, but of the concussion of air, exactly as if there had been an explosion of dynamite or gunpowder; and the windows of two houses close by were broken in the same manner and by the same cause. Before even the professor saw the tree he had expected to find not far from it a spring or a stream of water; for the presence of water near the root of a tree is often the determining cause of its attraction for the electric fluid. In effect the professor found, five metres from the poplar, on its north side, a leaden water-pipe, and close to it a drain filled with waste water from a laundry. The principal fissure in the tree was also on the north side; and half way between it and the water-pipe a plank lying on the ground had been pierced by a concentrated jet of the electric fluid as it flashed towards the pipe by the shortest route. Many trees, especially poplars, may be compared to buildings the lightning conductors of which are not continued to the ground. A building of this sort, if struck by the electric fluid, would in all probability remain intact in its upper part and be seriously damaged beneath the part where the conductor ceased. Hence, by far the safest part of a tree during a thunder-storm would be its topmost branches. This explains why birds are so rarely killed and their nests so seldom disturbed by lightning, while persons who have sought shelter under the spreading branches of trees are so often struck. The electric fluid, finding the trunk and the larger branches imperfect conductors, is easily attracted by surrounding bodies, whether they be bushes or human bodies. Large trees, especially tall poplars, placed near a house may serve as very efficient lightning conductors, but always on the indispensable condition that there is no well or running water on the opposite side of the house, for in that case the electric fluid, if it struck the tree, might pass through the building on its way to the water. In 1864 a house at Lancy almost in contact with a poplar on one side and a marsh on the other was set on fire by lightning, and the path of the electric fluid, from the point at which it left the tree, across the roof of the building to the marsh, could be distinctly traced. Hence, in erecting lightning conductors it is desirable that their lower extremities should terminate in a strean, a well, or a piece of damp ground. The plant most sensible to electricity is the vine. When a stroke of lightning falls in a vineyard the leaves affected are turned red-brown or deep green, a circumstance which shows, in the opinion of Professor Colladon, that the electric fluid descends in a sheet or shower, and not in a single point, the number of vines touched—sometime several hundred—by a single *coup* proving that the lightning had covered a wide area. This fact lends additional confirmation to the theory that lightning disperses itself among the smaller branches of trees and over ground covered by vegetation."—*Times*.

THE CITY AND GUILDS OF LONDON INSTITUTE.—A Laboratory and Tutorial course on Electrical Engineering will be held at this Institute every Tuesday evening from 7 to 9 p.m., commencing on May 25th. The course will be under the direction of Professor Ayrton.

AN electrical arrangement for automatically recording the notes played upon a piano was recently described to the Paris Physical Society, by MM. Leclerc and Vincent.

Correspondence.

BROOKS' UNDERGROUND TELEGRAPH SYSTEM.

To the Editor of THE TELEGRAPHIC JOURNAL.

DEAR SIR,—Yesterday I was at Versailles, and tested four of the conductors referred to by Mr. Aylmer. No. 1, after five minutes' electrification, gave an insulation resistance of 203 megohms per kilometre. No. 22, after five minutes, 254 megohms. No. 12, after one minute, 135; after two minutes, 193; after five minutes, 254. The insulation of No. 12 was taken again after being disconnected from battery ten minutes, and the other conductors connected to earth with the following results:—After one minute, 176 megohms; two minutes, 203; three minutes, 226; four minutes, 256; and five minutes, 256. These tests were taken between twelve and two o'clock. Temperature in the shade 80° Fahrenheit. The pipe containing the cable is covered with about a foot of gravel, the latter exposed to the sun. Mean temperature of the cable is supposed to be about 80° Fahrenheit.

Very truly yours,
DAVID BROOKS.

Hotel Meurice.
Paris, May 26th, 1880.

MY DEAR SIR,—I have much pleasure in complying with your request to give you the results of the tests I made on the 14th inst. of the length of your liquid insulated cable, which you laid down at Versailles in November last:—

No. of Conductor.	Insulation Resistance.		Electrostatic Capacity.	
1	178·5	megohms per kilom.	0·106	microfarads per kilom.
2	238·0	"	·087	"
3	223·1	"	·087	"
4	238·0	"	·087	"
5	198·3	"	·106	"
6	198·3	"	·106	"
7	198·3	"	·106	"
8	198·3	"	·106	"
9	223·1	"	·109	"
10	223·1	"	·109	"
11	223·1	"	·109	"
12	223·1	"	·106	"
13	223·1	"	·106	"
14	210·0	"	·106	"
15	223·1	"	·106	"
16	238·0	"	·109	"
17	223·1	"	·109	"
18	223·1	"	·106	"
19	223·1	"	·106	"
20	223·1	"	·109	"
21	223·1	"	·109	"
22	223·1	"	·106	"

The insulation tests repeated on each wire, when, at the same time, the ends of all the other wires were put to earth, gave practically similar results.

I may mention that, as the cable showed considerable absorption on slowness of full electrification, the readings for insulation were all taken after five minutes' electrification, and those for electrostatic capacity by discharge after one minute's electrification.

I am, my dear Sir,
Yours very faithfully,
Paris, May 25, 1880. J. AYLMER.

ANDRÉ'S LAMP AT THE ROYAL EXCHANGE RESTAURANT.

DEAR SIR,—Whilst strolling down Cheapside yesterday evening with a friend, he suggested to me that we should go to the Restaurant under the Royal Exchange Building, to see the André lamps, said to be there used for illumination. On arriving at the foot of the stairs, my friend, addressing himself to a young gentleman who stood by, asked a few questions as to the number of lamps used, &c. He replied that he did not know much about the matter, but that his uncle, who, I think he said, was managing proprietor, would soon be there, and would give us every information. That gentleman having arrived, he kindly stated in answer to our question, that he was very well satisfied with the light, and he claimed for it advantages over the *Jablochkoff* and all other systems on account of the *diffusion* of light obtained by it, and also eulogised it on the score of its *sombre* quality. He then directed his nephew to conduct us to the machine-room, on reaching which we were handed over to an attendant, who informed us that the engine was a 12 horse-power gas engine, and that two machines were working the lights then burning. I remarked that there were *three* being driven (out of five which were there), but he said that one was not in use. We were still conversing with this attendant when four or five individuals came towards us, two of whom intercepted our view of the machines by standing in the doorway, and one then stepped into the machine room and closed the door thereof in our faces, with the remark, that, "he must close the door to shut in the *noise*." We considered ourselves completely hustled off the scene, and are at a loss to understand why, if there is nothing there to be ashamed of any one seeing. Is the power absorbed by the lamps so tremendous that it must be kept dark? The 8 lamps I saw burning seemed to give nice little lights, in power ranging from about ¾ to 1 gas burner (12 to 16 candles), and did not flicker more than electric lights usually do when requiring slight regulation. I am indebted to the courtesy of the gentleman referred to for the permission given to inspect the lights, but he unfortunately was not present when the treatment I have described above was accorded to my friend, and

Yours truly,
May 27, 1880. ON LOOKER.

Proceedings of Societies.

THE SOCIETY OF TELEGRAPH ENGINEERS.

AN ordinary general meeting of this Society was held on Wednesday, May 26, Mr. W. H. PREECE, President, in the chair. The minutes of the last general meeting having been read, and a list of new and proposed members read,

Mr. EDWARD GRAVES read a paper on "A Decade in the History of English Telegraphy." The author commenced his paper by stating that he only proposed to deal with English telegraphy proper, exclusive entirely of the submarine cables used for connection between our islands and the continents of Europe and America.

In 1846 the first telegraph company in England was incorporated; in 1850-51, the British Telegraph Company, the European Telegraph Company, and the Magnetic Telegraph Company all came into existence. After various vicissitudes, these companies, or what remained of them, amalgamated under the name of the British and Irish Magnetic Telegraph Company. This was in 1857.

Later still, in 1860 or 1861, the United Kingdom Telegraph Company, which had been projected many years before, assumed a real existence. This company differed from the former companies, inasmuch that it was wholly unconnected with railways.

Then various local companies were established.

The London District Company, afterwards termed the London Provincial Company, had its sphere in the metropolis and suburbs.

The Bonelli Telegraph Company, between Manchester and Liverpool.

The Economic Telegraph Company, and several others whose existence was ultimately unprofitable, and whose careers were brought to a more or less untimely end.

About 1861 the Universal Private Telegraph Company was started.

In 1869 there were existing in the United Kingdom no less than twenty-nine separate undertakings specially devoted to the transmission of telegraph messages, wholly independent of railway companies, who employed their wires secondarily for the same purpose.

There were certain railways which were carrying on telegraph business on a comparatively large scale. The districts occupied, for example, by the South Eastern Railway, London Chatham and Dover Railway, the London Brighton and South Coast Railway, and the North British Railway Company, had either never been wholly handed over to the telegraph companies, or had been taken out of their hands, so far as it was in the power of the railway companies to do so, prior to the date referred to, *i.e.*, 1869.

These railway companies were compensated for the actual business they were doing, and others obtained compensation in consideration of the loss of their reversionary power of carrying on such business, *i.e.*, when free from their engagements to telegraph companies.

In some instances a telegraph company and a railway company treated with each other as independent powers, but worked together.

In 1868 the Post Office were authorised to buy up and extinguish existing interests in commercial telegraphy.

The Telegraph Act of 1868 did not contemplate granting a monopoly to the Post Office, but before the Money Bill to make good the purchase was authorised in 1869, the political authorities had determined that a monopoly of the right of sending telegrams for money was necessary, and it was therefore acquired.

The year 1869, the last complete year of the telegraph companies, was, in some sense, a period of stagnation. The arrangements made with the Government practically put an end to their future career in 1868, and until the purchase was completed their main object was to spend as little as possible, so as to realise the utmost immediate profits.

To make a fair comparison, therefore, it is proposed to take the period when the active exertions of the companies were suspended, and compare its results with those attained in the year 1879, when for ten years the commercial telegraphs of the country had been transferred to the State.

In 1869 the lines of telegraph available for public use extended from Penzance to Wick, and from Lowestoft to Galway. In fact, the succeeding ten years have only carried them on to Scilly and the Shetlands, so far as regards the main north and south routes. But while the country was traversed by electric lines it was not covered by them: they were very widely severed in some districts. Whole counties were dependent upon a single thread of communication, and towns far from a railway were in many instances utterly ignored. The telegraph had penetrated to places where commercial activity was rife, and whence profits could be drawn; but it had not been utilised for the benefit of rural districts, nor had it as a rule been established where commercial success could not be reckoned upon. In fact, the only chance of finding a telegraph office in a village was in the event of its also being a railway station where there was a telegraph available primarily for railway purposes, or of a trunk road line passing through to some large seat of commerce, upon which the company had established an intermediate office.

In 1879 the country was almost uniformly dotted over with telegraph offices. Commercial considerations alone have not been kept in view, and telegraphic facilities have been given in many instances to very small communities far from any commercial centre.

In 1869 the total number of telegraph offices was 2,488, railway stations open for telegraph business included.

In 1879 it had reached 5,331.

But the increase of convenience is in reality much greater than is expressed by these figures.

In 1869 there were three, and in some cases four companies all competing with each other, and all having offices in the same quarters of large towns, very often close together. So that, although a town might contain three telegraph offices, the accommodation to the inhabitants was really only that of one.

Under the present *régime* all this is changed; and to express the difference in the accommodation given, at least 500 offices should be deducted from the number of those formerly existing.

In 1869 the total number of messages transmitted by the companies was, as far as can be estimated, from 6,000,000 to 6,500,000.

In making comparisons, the fact has often been overlooked that each company counted the number of messages passing over its own wires without regard to the fact that the same messages were counted again on the wires of another company. In some cases a message may have been counted three times over, thus the total number of messages transferred from one company to another was very large, and in consequence the published figures on the point are vitiated by a great inaccuracy.

The total number of messages transmitted over the English land lines in 1879 (more exactly for the financial year ending 31st March, 1880) was 26,547,137, being an increase of more than fourfold over those of the corresponding period ten years ago.

In 1869 the total number of miles of wires used exclusively for commercial traffic was under 50,000, some part of which length was by the provisions of the Acts of 1868 transferred to railway companies upon the acquisition of the telegraphs by the State, and does not now count as commercial wire.

In addition, the telegraph companies had the partial or secondary use of the railway wires.

(To be continued.)

PHYSICAL SOCIETY.

THE annual holiday meeting of this Society was held on May 22nd, at Cambridge. On arrival there the party partook of luncheon in a hall of St. John's College, which had been kindly arranged for the purpose by the College authorities. Prof. W. G. ADAMS, occupied the chair; and Mr. WARREN DE LA RUE proposed a vote of thanks to the Master and Senior Fellows of the College for providing the hall. The vote was heartily accorded by the members; and after some remarks from Prof. ADAMS the party proceeded to the Cavendish Laboratory, where Lord RAYLEIGH, as Vice-President of the Society, presided. The routine business of the

meeting being waived, Lord RAYLEIGH described a plan for limiting the slit of a telescope so as to alter the angular interval with which it can deal. The interval is measured by means of a grating formed by winding a fine wire round two parallel screws of very fine thread.

Mr. SHAW exhibited a modification of Veinholdt's apparatus for distilling mercury, by which a kilogram of mercury can be distilled per hour.

Mr. SYDNEY TAYLOR exhibited a device for showing the motion of the particles of water in the transmission of a surface wave. Sixteen discs were arranged in single file, each having a white spot on its face, and on turning a handle the discs rotated so that the spots, which represented particles of water, moved so as to present a wave motion to the eye. Mr. TAYLOR also showed a manometric flame apparatus for exhibiting to the eye the difference of phase between two musical notes. This consisted in two bent tubes into which the notes were sounded, and capable of being lengthened or shortened by hand like the pipes of a trombone. Opposite the ends of each of these tubes a sensitive flame was placed and a rotating mirror showed the disturbance produced in the flames by the two different notes. A third flame exhibited the joint effect of the two notes. When the tubes were silent the images of the flames on the revolving mirror were seen as plane bands, but when notes were sounded into the tubes they became serrated, and the serrations were like or unlike according as the phases of the notes were like or unlike.

Mr. POYNTING exhibited a plan for altering the plane of polarisation of the two halves of a pencil of rays from the polariser, so that half the field may be made to appear dark when the other is bright, or both of equal brightness at will.

Mr. GLAZEBROOK described a method of measuring the rotation of the plane of polarisation of light by means of two spectra giving dark lines made to coincide.

Lord RAYLEIGH described a plan for demonstrating that yellow colour can be formed by combining red and blue together. He mixes a red solution of chromate of potash with a blue solution of litmus, and on filling it into a glass cell of a certain thickness the light transmitted through it is seen to be yellow. Plates of glass coated with gelatine impregnated with litmus and gelatine impregnated with chromate of potash and placed side by side also transmit yellow light. Lord RAYLEIGH finds, however, that the eyes of different persons vary considerably in their power of appreciating the tinge of the transmitted yellow; one deeming it greenish, another reddish, while a third considers it pure yellow. This peculiarity is not to be confounded with colour blindness, since all three persons would distinguish the red and green components accurately. Lord RAYLEIGH also exhibited a colour-box, based on the Newtonian principle, first carried out by the late Professor Clerk-Maxwell, but of a small size.

Sir W. THOMSON then proposed a vote of thanks to Lord Rayleigh, which was seconded by Prof. W. G. ADAMS, and the meeting then dispersed to examine the apparatus and appointments of the Cavendish Laboratory.

New Patents—1880.

1934. "Instruments or appliances for adjusting and correcting deviations in the mariner's compass." H. J. THATCHER. Dated May 11.

1942. "Improvements in and relating to apparatus for transmitting fire-alarm and other signals." W. P. THOMPSON. (Communicated by J. F. M. Bartelous.) Dated May 12.

1954. "Improvements in sound articulators or instruments to assist the sense of hearing through the teeth or bones of the head." W. CLARK. (Communicated by O. D. Orvis.) Dated May 12.

1958. "Improvements in and relating to telephonic exchange systems." J. H. JOHNSON. (Communicated by G. L. Anders and T. A. Watson.) Dated May 12.

1960. "Insulators for supporting and securing telegraph and other wires." G. WELLS and A. GILBERT. Dated May 13.

1998. "Magneto-electric machines." W. R. LAKE. (Communicated by C. A. Seeley.) Dated May 14. (Complete.)

2020. "Means and apparatus for continuous electrolytic action." C. D. ABLEL. (Communicated by L. Wollheim.) Dated May 18.

2037. "Electric lamps." W. CLARK. (Communicated by P. Drew.) Dated May 19. (Complete.)

2049. "Signalling on railways and apparatus therefor." W. T. C. PRATT. Dated May 20.

2114. "An improved manner of and mechanism for perforating paper for telegraphic purposes." W. R. LAKE. (Communicated by T. M. Foote and F. Anderson.) Dated May 24. (Complete.)

2136. "Improvements in and relating to call or signal apparatus for telephonic or telegraphic purposes." W. R. LAKE. (Communicated by C. S. Eaton.) Dated May 25. (Complete.)

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1879.

3927. "Galvano-plastic process." W. E. GEDGE. (A communication from Cyrille Bonaz.) Dated Sept. 30. 6d. Relates to a process by which it is proposed to render easy and practical the reproduction in a single piece of all kinds of objects or articles in alto-relievo. For the purpose of bringing the positive current into the mould either an anode jointed or linked like a chain, or an anode formed of a continuous metal wire or of a plate, also metallic, is used. This chain, wire, or plate, is surrounded with a suitable insulating substance incorruptible or unalterable in the bath, and having numerous openings. These anodes, in sufficient number to fill the entire cavity of the mould, are then introduced into it, and the whole being carried to the reduction bath, the anode and the mould being connected the one with the positive and the other with the negative pole of the source of electricity, the metallic solution decomposes, and the metal deposits over the inside of the mould.

3954. "Medico-galvanic electrode." ISAAC LOUIS PULVERMACHER. Dated October 2. 2d. Consists of a medico-galvanic electrode, magnetic at will. Triangular thin copper and zinc plates are fixed in alternate order on one or more superposed circular discs of thick stiff cotton, linen, or woollen cloth, or cardboard, by overlapping edges at the inner and outer edges. The central hole thus formed receives a metallic piece, having a pin in its centre, the whole being similar to a drawing pin, the head of which is slightly larger than the central hole in the apparatus or appliance. The centre pin is on its thicker or lower portion threaded to receive another disc, of the same size as the "head," and acting as a nut. To render this appliance magnetic at will, a circular magnet may be inserted between the two cloth discs during manufacture. *(Provisional only.)*

4189. "Electric telegraph terminal and shackle insulators." C. E. CRIGHTON. Dated October 16. 6d. Has for its object the production of a terminal or shackle insulator, so constructed as to render the insulation of electricity more perfect than is attainable by the insulators at present used for terminating and shackling the telegraph wires of aerial lines. To the horizontal arm carried by the telegraph post is attached an insulated hollow conical body by means of a metal encircling strap and bolts, around which body is placed another insulating body or shed, which partially encloses the former, and is attached thereto by cement or otherwise. Through the centre of these parts so combined passes a conducting rod or bolt for forming the connection between the subterraneous wire and the aerial wire and receiving the strain of the latter. The central body, before mentioned, is provided upon a portion of its length with alternate annular or surrounding recesses and projections, the object being to retard the passage of rain or moisture from the conducting rod or bolt to the strap, which attaches the insulator proper to the horizontal arm. In the case of shackle insulators, as no connection with a subterranean wire is required, the bolt and its appurtenances are modified, as will be well understood. The claims are four in number, first—a terminal insulator, forming the connection between the subterraneous wire and the aerial wire in the interior of the insulator. Secondly, in a terminal or shackle insulator, the combination of an insulating hollow body, conical on its interior and exterior, a metal encircling strap with attaching bolts or connections to a telegraph arm, and an internal conical plug for receiving the strain of the aerial wire. Thirdly, in a terminal or shackle insulator, the employment of an insulating hollow conical body enclosing a conducting rod or bolt for receiving the strain of the aerial wire, the said hollow conical body having alternate annular or surrounding recesses and projections for preventing the continuity of damp. Fourthly, the general arrangement and combination of parts.

City Notes.

Old Broad Street, May 28th, 1880.

GERMAN UNION TELEGRAPH AND TRUST COMPANY.—THE ninth ordinary general meeting of the above Company was held on May 11th at the City Terminus Hotel, Sir James Anderson presiding. The report for the year ending the 1st instant stated that the total receipts during the year amounted to £12,227 17s. 6d., which, with a balance of £40 4s. 5d. carried forward from last account, made a total of £12,268 1s. 11d. The working expenses for the same period amounted to £462 13s. 3d., leaving a balance of £11,805 8s. 8d. Out of this amount an interim dividend of 5s. 9d. per share was distributed on the 21st January last, and the directors now begged to recommend the payment of a further dividend of 6s. per share, making a total distribution for the year of 11s. 9d. per share, free of income tax, or at the rate of £5 17s. 6d. per annum upon the capital of the Company, and the directors had also written off £74 17s. 3d. from the expenses of formation of the Company, leaving a balance of £51 1s. 5d. to be carried over to the next account. The Company's cable and land lines remained in good order and condition, and business during the last year had been going on in a satisfactory manner. The Telegraph Conference, held last year in London, had led to the introduction of some important changes, such as the general introduction of the one word rate, and the reduction of tariffs, which so far had led to a diminution of revenue. The Chairman moved the adoption of the report and accounts and the payment forthwith of the dividend recommended. In doing so, he referred to the origin of the Company, which he said was started as a purely German company. At the instance of the leading shareholders, however, it had been made as far as possible an English company, but the English board were only the agents of the Berlin directors. The work of the Company in London was really done by the Submarine Company. The Anglo-American Company allowed them a certain rebate on messages transmitted over their line until the German Union dividend of itself amounted to 10 per cent. The real point in the report was that besides paying a fairly good dividend they had a reserve fund of £12,800, and a renewal fund of £6,280. He thought the Company might therefore be considered a good one. Mr. H. G. Erichsen seconded the motion, and it was carried unanimously, and the retiring director and auditor were re-elected. The proceedings then closed in the usual manner.

REUTER'S TELEGRAM COMPANY, LIMITED.—The sixteenth ordinary general meeting of the shareholders of this Company was held on May 19th at the Company's offices, 24, Old Jewry, for the reception of the report and balance-sheet, the declaration of a dividend, and the election of a director and auditors. Colonel James Holland, the chairman of the Company, presided. The report stated that the net profits for the year ending the 31st December last amounted to £7,101 4s. 4d. including £113 9s. 4d. brought forward from the last account. A dividend of 8s. per share, or 5 per cent., was declared, which, with the interim dividend of 2½ per cent. paid in October last, made a total of 7½ per cent. for the year. Fifteen hundred pounds was added to the reserve fund, and the balance of £108 14s. 9d. was carried forward. The Chairman, in moving the adoption of the report, said that the profits of the year had amounted to nearly 10 per cent., which, having regard to the general depression of trade, was, he thought, very satisfactory, and there was no reason to suppose that the success of the Company would not continue. The report was adopted, and Mr. Stopford, a retiring director, was re-elected. The auditors, Messrs. Quilter, Ball, Crosbie, and Co., were also re-elected. The lease of the Company's offices expiring at the end of the present year, the directors have decided on purchasing the freehold. For the purpose of enabling them to do this an extraordinary meeting was then held, at which a resolution proposed by the Chairman, and seconded by Baron De Reuter, authorising the directors to raise the sum of £10,000, for the purpose of completing the purchase of the Company's offices, and for other purposes, was carried unanimously. It was stated that the price to be paid for the premises was £13,000, of which £6,000 would be paid out of the reserve fund, and the remaining £7,000 out of the £10,000 which it was proposed to take power to borrow. A vote of thanks to the chairman brought the proceedings to a close.

LONDON PLATINO-BRAZILIAN TELEGRAPH COMPANY, LIMITED.—The ordinary general meeting of the shareholders of this Company was held on May 25th, at the offices, Old Broad-street, Mr. J. Pender, M.P., in the chair. The report stated that the accounts for nine months, ending March 31 last, showed that, after setting aside a sum of £1,200 for the reserve fund, and charging the interest on the debentures, there remained a net revenue of £5,480 17s. 9d., to which was added the balance of £5,719 4s. carried forward from July last,

making a total of £11,200 15. 9d. to the credit of revenue account. Out of this the directors recommended the declaration of a dividend of 2s. 6d. per share, free of income tax, which would absorb £4,768 10s. leaving £6,431 11s. 9d. to be carried forward, pending the collection of the debt due from the Uruguay Government. The transfer of the assets and property of the Company from the Brazilian Company to the English Company had been completed, and nearly all the shares had been sent in for exchange and certificates of the English Company issued to the shareholders. In consequence of the provision of the articles of association that the general meetings of this Company should be held in May, it had been found necessary to make up the present accounts for a period of nine months. In future an interim half-yearly dividend would be declared by the board, and the yearly accounts would be made up and presented at the general meeting in May, when a final distribution would be made. The Company's submarine and land lines were in good order. The Chairman, in moving the adoption of the report, said that this was nearly the first meeting since the Company was constituted an English company, and it might be said their affairs were now fully under the management of the present board. Looking to the improved position of the Western Brazilian Company, their prospects were decidedly better. They were likely to get £20,000 this year, against £17,000 during the past two years. They had received a telegram from their agent abroad to the effect that £1,000 had been remitted, but whether it was towards the reduction of the Government debt or not they did not yet know. It was, however, an evidence of growing vitality. If the Government would only keep up to the mark their earnings would show a much better result; but, unfortunately, their arrangements with the Government were such that they were obliged to carry on the traffic whether it paid or not. Since the present directors came into office the revenue of the land lines showed a steady growth. The resolution was seconded and carried unanimously, and the dividend of 2s. 6d. per share having been declared, Mr. J. Pender, M.P., the retiring director, was unanimously re-elected. The retiring auditors having been also re-elected, a vote of thanks to the chairman closed the meeting.

THE WEST COAST OF AMERICA TELEGRAPH COMPANY, LIMITED.—Notice is given that the third ordinary general meeting of the Company (adjourned from the 23rd day of April, 1880) will be held on Friday, the 4th day of June, 1880, at the Cannon Street Hotel, in the City of London, at 12 o'clock noon. In consequence of the war, the final accounts from the stations on the West Coast have not yet been received, but they may arrive by the mail of the 28th inst., in which case every effort will be used to complete the accounts for the past year, for submission to the shareholders at this meeting. Mr. Knowles and Mr. Gray are the directors retiring by rotation, and being eligible, offer themselves for re-election. The auditors, Messrs. C. F. Kemp, Ford, & Co., Public Accountants, also retire and offer themselves for re-election.

The following are the final quotations of telegraphs:—Anglo-American Limited, 62¾-63½; Do., Preferred, 92-93; Ditto, Deferred, 34½-35; Black Sea, Limited, ——; Brazilian Submarine, Limited, 8¼-8½; Cuba, Limited, 9-9½; Cuba, Limited, 10 per cent. Preference, 15¼-16½; Direct Spanish, Limited, 1¾-2¼; Direct Spanish, 10 per cent. Preference, 10¾-11¼; Direct United States Cable, Limited, 1877, 11⅜-11⅝; Scrip of Debentures, 100-102; Do., £50 paid, par-2 pm.; Eastern, Limited, 8⅞-9⅛; Eastern 6 per cent. Preference, 12¼-12½; Eastern, 6 per cent. Debentures, repayable October, 1883, 101-104; Eastern 5 per cent. Debentures, repayable August, 1887, 101-103; Eastern, 5 per cent., repayable Aug., 1899, 102-104; Eastern Extension, Australasian and China, Limited, 9-9¼; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 107-110; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 102-104; Ditto, registered, repayable 1900, 102-105; German Union Telegraph and Trust, 8¾-9¼; Globe Telegraph and Trust, Limited, 5⅞-6⅛; Globe, 6 per cent. Preference, 11⅞-12⅛; Great Northern, 9¼-9⅝; Indo-European, Limited, 23-24; London Platino-Brazilian, Limited, 4¼-5; Mediterranean Extension, Limited, 2¾-3¼; Mediterranean Extension, 8 per cent. Preference, 2¾-3¼; Reuter's Limited, 9½-10½; Submarine, 230-240; Submarine Scrip, 2½-2¾; West Coast of America, Limited, 1¾-2; West India and Panama, Limited, 1⅝-1¾; Ditto, 6 per cent. First Preference, 7¼-7⅝; Ditto, ditto, Second Preference, 6¼-7; Western and Brazilian, Limited, 6⅝-6¾; Ditto, 6 per cent. Debentures "A," 100-103, Ditto, ditto, ditto, "B," 100-103; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 117-122; Ditto, 6 per cent. Sterling Bonds, 103-105; Telegraph Construction and Maintenance, Limited, 33½-34 Ditto, 6 per cent. Bonds, 106-109; Ditto, Second Bonus trust Cerificates, 3¼-3½; India Rubber Company, 14-14½; Ditto 6 per cent. Debenture, 104-106.

TRAFFIC RECEIPTS.

Name of Co., with amount of issued capital, exclusive of preference and [debenture] stocks.	Anglo-American Co. £7,000,000.	Brazilian Sub. Co. £1,300,000.	Cuba Sub. Co. £160,000.	Direct Spanish Co. £116,379.	Direct U.S. Co. £1,213,900.	Eastern Co. £3,697,000.	Eastern Ex. Co. £1,997,500.	Gt. Northern Co. £1,500,000.	Indo-Euro. Co. £425,000.	Submarine Co. £338,225.	West Coast America Co. £300,000.	Western and Brazilian Co. £1,398,200	West India Co. £883,210.
	£	£ a	£	£	£	£	£	£	£	£	£	£	£
April, 1880 ...	*	15,525	3,100	... ...	*	44,748	24,342	18,360	... ...	*	... ...	13,402	4,591
April, 1879 ...	45,540	12,885	3,140	803	15,180	37,846	21,060	16,299	... ...	10,195	4,225	10,526	5,240
Increase	... ...	2,640	... ...	... ...	... ...	6,902	3,282	2,061	... ...	... ...	... ...	2,876	... ...
Decrease	... ...	... ..	40	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	649

* Publication of receipts temporarily suspended.

a Five weeks compared with one calendar month.